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Palm trees reuses as sustainable element in the Sahara. The case of Ziban, as self-sustainable urban units

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Abstract

The lower Algerian Sahara is experiencing an unprecedented urban growth, causing a socio-spatial upheaval and an ecological imbalance of oasis ecosystems that are embodied in the detachment of *the palm trees* from the urban areas. This detachment actively participates in the increase of the Urban Heat Island, as well as the over-urbanization on the account of farmlands. Hence the abundance of palm groves, participates in the activation of desertification. Yet urban growth in the Saharan regions had been done since a long time taking the shape of oasis networks composed of small centres that functioned as "oasis villages.", [1] the ecological growth took place based on three variables, the first population, the second human settlement: Ksour plural of Ksar and Dachra, the former is more urbanized than the latter, and the third palm trees which was both a terrain roof minimizing solar gain and a windbreak protecting human settlements from sandstorms. The *Ziban*, plural of Zab, and the Amazigh appellation of oasis, represented one of the oasis networks. These variables would be the subject of study of the quantitative relationship between these three parameters. This relationship can give us the first measures in designing sustainable urban units friendly to that too hostile environment. Our work will be based on the comparison of 2009 statistics with 1904 statistics, because this year represents the initial state of the oases of *Ziban*. Finally we will try to propose a remedial project through tourist tours to reunite this *Ziban*.

key words: The palm grove, population , Ksour and Dachra, self-sustainable urban units, *Ziban*.

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1. Introduction

Rapid urbanization, as the result of *population* growth and migration from rural to urban areas, changes both the structure and function of our cities. It leads to severe changes in the physical, social and environmental conditions [2] by affecting the climatology of cities and their surrounding areas. These changes have a direct, immediate, and significant impact on human settlements, ecological diversity, energy flows, and climatic conditions [3] from local to regional scales.

2. Study problem

Urbanization is one of the major problems especially in the Saharan region. Dealing with this growth in a sustainable manner is a major challenge. [4] Strong instruments to integrate ecological, economic and social aspects early in the planning of Saharan regions and decision-making process are needed to deal with the major upcoming problems like resource and energy consumption, waste disposal, water salinity and desertification.

A sustainable city can feed and power itself with minimal reliance on the surrounding countryside, and creates the smallest possible ecological footprint for its residents. This results in a city that is friendly to the surrounding environment, in terms of pollution, land use, and alleviation of global warming.

We need to understand the structure, function, and dynamics of oases systems at different states in time, in order to predict change processes in oases of micro region *Ziban* with fragile ecosystem focusing on how to preserve the natural resources, mainly palm trees

3. Study objectives

The first objective in this dissertation is in the first place to compare the growth of *population* and its palm trees to find if there is a ratio between them and define it, in the second place is to compare the area of human establishment (*Ksour and Dachra*) with the crooned palm grove.

The second objective is to propose a transport system based on tourist towers in order to create a link between *ksour and Dachra* of the *Ziban* and requalify them into *self-sustainable urban units*.

Specifically, this research will focus on three critical questions

What is the sustainable factor in the *Ziban*?

How the *Ziban* illustrated a self-sustainable urban unit?

How can we reuse and revitalize the sustainable factor in the *Ziban*?

4. Method

In this dissertation, the comparative and analytic approach used, is based on the study of statistics of palm trees and *population* from 1904 to 2009, by analyzing the oasis process over a long term.

To create a Geographic Information System GIS we use the health-mapper software specialized in collecting information. We also use aerial photographs from google-earth and Autocad software.

5. Definition of the case study, the Ziban

5.1 Situation and geographic characteristics:

The *Ziban* lies on the southeast of Algeria, at the southern foot of Saharan Atlas' mountain range. This site makes it deserving "The gate of desert" connotation.

This allowed the region to play through the different periods of its existence, a role of encounter exchanging and transition, between a well equipped north and a disinherited south. (Fig.1.a)

Fig. 1. (a) The location of Biskra in Algeria. Source: TDMP [5]. (b) The relief of micro region. Source: Health-mapper

The relief of this micro region is divided into four major groups: the mountain range and high plateaus, great plateaus; steppes and depressions. This whole is irrigated by a set of wadis that form the main gatherer of the Saharan Atlas' waters. (Fig.1.b)

The climate of the micro-region is desert-prone arid and semi-arid, with a high temperature in summer reaches (48.8°C), in August, and (1.6°C) in February. Because of the desertification phenomena we get a longer and a hotter summer and dry and shorter winter, with a 139, 8 mm / year of average rainfall [6].

5.2. Ziban as self-sustainable urban units

The micro-region was divided into four Zab [7] (Fig.2) each one has its own palm groves, and cultural and architectural heritage, each one is also independent economically and politically, [8] for example Zab Biskra produce some dates and it was the an open market for change all kinds merchandises, Zab Guebli, Zab Dahraoui are specialized in the production of dates and Zab Chergui produce cereals and medicinal plants.

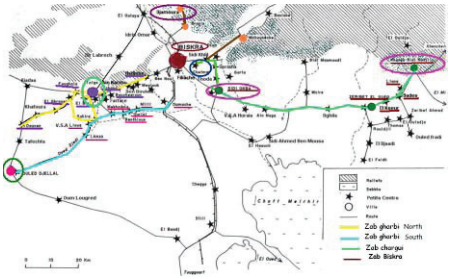


Fig. 2. The smaller urban units and their Capitals. Source:. Marc Cote [9]

The urban distribution of the region of *Ziban* was based on the potentialities of *Ksour and Dachra*: its palm plantation, its agriculture and quite other constituent elements of the socioeconomic development. Every oasis was independent economically and politically and has its own architecture, its own devices and spatial organizations. That's why the *Ziban* illustrate one of the best sustainable and urban forms in fragile-ecosystem oasis areas, through adaptation, environment respect and exchange of ecological advantages with this environment. [10]

Geographically, the continuum of these oases is an important part of the Lower Algerian Sahara which has several natural resources. These oases have provided since ancient times a prosperous life for its inhabitants. [11]

6. The factor of sustainability in the Ziban

The number of ancient urban development remains the bedrock of urban reality of today or the rationale for an urban renewal operation. [12] At the time the *Ziban*'s oasis heritage is threatened with extinction, which has allowed us to read cultures and societies traces' that had been experienced this is palm groves and the ruins of old human settlements also made of trunks of palm trees. The initial implantations profit from the proximity of *the palm grove*s that had often surrounded the building ...further had helped to the creation of microclimate. [13] In a palm grove, the temperature drops to 10 °C, which can be beneficial to the functioning of: forest and oasis ecosystems, for ecotourism or for life around these spaces. These plants are indeed remarkable markers of ecosystem functioning. [14]

What introduces us the sustainability factor in the micro region of *Ziban* that is the palm tree. The palm tree is the natural, the economic and the social capital of *Ziban*. The environmental conditions of a city often depend often on the natural environment where it is situated. [15]

6.1 The palm capital of economic sustainability:

Trade always had a significant place in the oases of *Ziban*, because of fertile soils and palm groves [16] which are the backbone of the oasis ecosystem, and also of the agricultural character of social life essentially by revealing:

- An ecological role allows to limit desert encroachment and to improve residents' incomes.
- The creation of a microclimate permitting the good development of underlying crops;
- Under these canopies of 20 to 30 m height, light creates luminous pleasant livable atmosphere.
- The reduction of wind speed, and the curb of cicadas' proliferation;
- Palm trees' hedge protects crops, resists storms' damages, cyclones and fires, also it fights against erosion. It improves water reserves in dry soils and the climatic conditions of life.
- As stabilizer and regulator of cultures, the palm tree prevents landslide and minimizes land's salinity.

6. 2. The palm, capital of urban sustainability:

On the mass, the *Ziban*'s Ksour appear as urban groups protected by *the palm grove*, from sand winds and rays sunlight (Fig.3). Ksour heights' does not exceed the ones of *the palm trees*. Based on aerial photos (Google Earth) and AutoCAD software we tried to find the relationship between the surface of the Ksar and the surface of the surrounding palm grove, in the following paragraph.

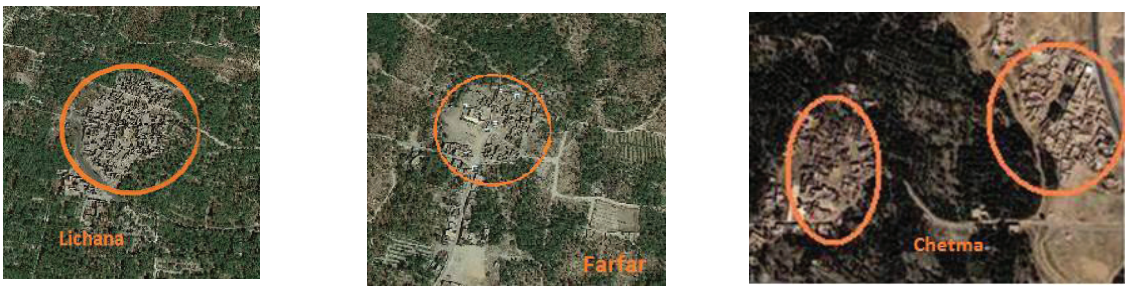


Fig. 3. (a), Human groups and their palm groves case of Lichana (b) Farfar (c) Chetma Source: Google Earth

6.3. The palm, capital of architectural sustainability:

Ksour and Dachra meet climatic requirements through ingenious modes of construction, and reveal, in a subtle way, bioclimatic habitats patterns and the workings of the social organizations. [17] The palm tree was used for ecological purposes: its wood and palm provide construction wood and tissue for houses and fences. Fig.4. (a) It trunks offer planks of construction, poles, beams and lintels (Fig.4. b). From the base of the trunk at the forefront of Palms, everything is recycled and turned into everyday objects. [18]

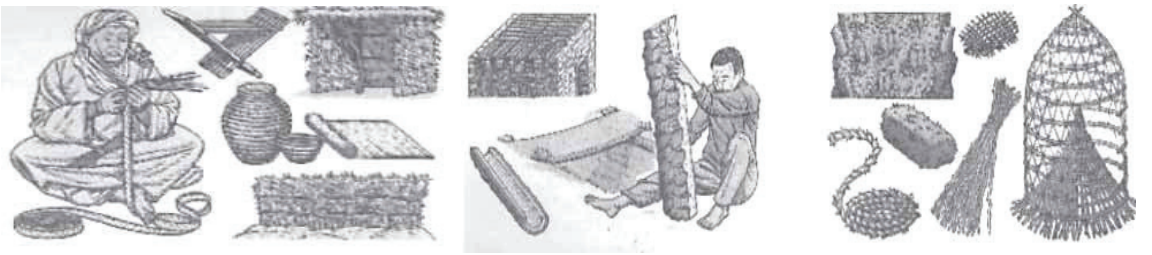


Fig.4. (a). it is used as ropes, to produce carpets and Jar's cover (b) The trunks used as planks. Source: Brac de La Perrière [19]

6.4. The palm, capital of social sustainability:

The date palm plays a major role in ensuring social stability of Zibanese oases population: it contributes in keeping knowledge and traditional skills that allow a judicious and sustainable use of natural resources, whether water in irrigation techniques, in the choice of suitable cultivars.

Plant biodiversity of palm trees has a real value based on historical, technical and agricultural links between groups and individuals and their cultural and social functioning. [20]

The number of palm trees was related to the number of males in the family, because they were the ones who cultivated *the palm trees*: The more the number of males increased the more they acquired more lands.

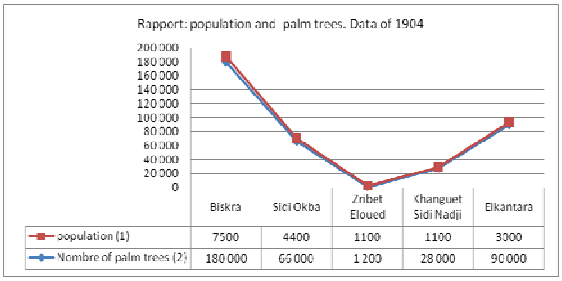
7. Data analyses

7.1. Rapport between the population and its palm trees:

The comparison is based on the choice of important capitals of the Zab Chergui, Zab Biskra and Zab El Kantara in the micro-region on the one hand on the other hand, the availability of old statistics.

The comparison between the curves of Fig.5 shows that there's a ratio between *population* growth and its palm trees that has been unbalanced after the interference urban sprawl.

According to the graph of *(Fig. 5.a)*, we observe that the two curves i.e. of *population* and palm trees are identical. This fact reflects the agrarian and oasis lifestyle of the micro region, and assures the strategic importance of palm trees as a stabilizing factor, socially and economically. So the relationship between the growth of palm trees and the *population* is a proportional relationship.



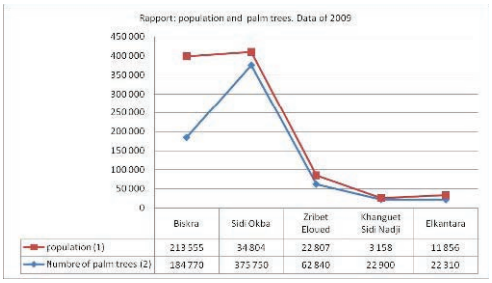


Fig. 5. (a) The rapport/ *population* and palm trees, examples of some capitals of *Ziban*, Source: Colonel Delartigue 1904 [21]
(b) The rapport/ *population* and palm trees, examples of some capitals of *Ziban*, Source: wilaya's monograph.2009

According to the graph of *(Fig. 5.b)*, the two curves can be divided into four parts:

Biskra: we notice a decline in the number of palm trees and an increase in *population* explained by this separation of *population* curve from that of palm trees, owing to a total changeover from the agrarian oasis lifestyle into an urban lifestyle, in addition to the spread of urban sprawl on the account of agricultural land, resulting in, and to detach from *the palm trees*. In this part of the curve the relationship is almost zero.

Sidi Okba: the two curves (*population* and palm) are almost identical, reflecting a parallel growth between the people and *the palm trees*. What proves the existence of compatibility between the urban way of life and the agrarian and oases lifestyle. So the relationship between the growth of *the palm trees* and the *population* is a proportional relationship.

Zribet Eloued: is still characterized by its agrarian lifestyle.

Khanguet Sidi Nadji and Elkantara: The two curves are virtually identical, reflecting an increase in *population* and a decrease in palm trees, and leading to a total rupture with the oasis lifestyle.

The rapport of the studied relationships is better explained in the following table:

Table 1. The ratios between the *population* and its palm trees before and after the growth in some capitals of *Ziban*,

Capital	Ratio1904 palm/person	Ratio 2009 palm/person
Biskra	24	1
Sidi okba	15	11
Zribet Eloued	1	3
Khanguet sidi Nadji	25	8
ElKantara	30	1

As for the data in (Table 1.) the ratio of 19 palm trees per person was the result of the addition of the whole ratios of 1904 and its division by the number of capitals.

But in 2009, the result was a ratio of 4.5 palm trees per person. So from 1904 to 2009, there was a deficit of 14.5 palm trees per person.

7.2. Rapport between the ksar and its palm grove:

The choice of the *Ksour and Dachra* in this comparison is base on the availability of the steel existing occupied area.

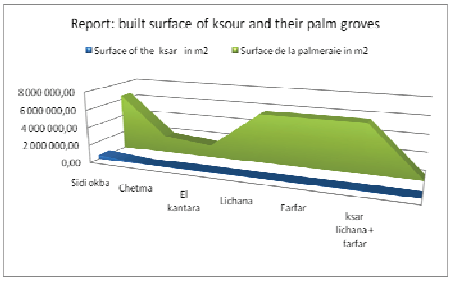


Fig. 6. Graph Report: built surface of ksour and their palm groves some examples of the *Ziban* Source: wilaya's monograph.2009 and Auteur

According to the graph in (Fig.6), we find that the surface of the Ksar is almost negligible compared to the surface of its palm grove. The following table we have tried to calculate the ratio which is the result of dividing the surface of the palm / on the surface of the Ksar.

The surfaces of the Ksar of Lichana and the Ksar of Farfar are assembled in because they share the same palm grove. Remember that what interest us is the ratio, Ksar (constructed area) and its palm grove. Apart Sidi Okba which represents a large capital, from (table 2) we find that the built area of ksour as sustainable urban units is limited between 20 000 m2 and 50 000 m2.

Table 2: built surface of some ksour and their palm grove source author.

ksar, Dachra…	Total surface The ksar and its palm grove in Ha	Surface of the ksar in Ha	Surface of *the palm grove* in Ha	Rapport: surface palm grove / surface ksar
Sidi okba	65	4,3	15	15,25 ≈ 15
Chetma	20	0,25	80	79,77≈ 80
El kantara	14	0,5	28	2,81≈ 3
Lichana	55	0,35	157	158,73
Farfar	55	0,25	220	230
ksar Lichana + Ksar farfar	55	0,6	90	93≈ 90

Outside of El-Kantara with its different geographical characteristics of the remaining ksour the ratio exceeds greatly the surface of the Ksar. Facing this rapid urban growth that has been done on account of the agricultural land, palm groves, and quality of life; does it become obligatory to curb this sprawl and return to an urban concentration that would reduce energy consumption and outlying environments destruction? [22] To do so, one must bring an end to this triple neglect: of the city, of its ecosystem and of its heritage. [23]

The micro region must keep its oasis identity while progressing. A revitalization of its *ksour and Dachra*, through the rehabilitation of tourist tours; can revive the human establishments by the receiving of tourist dynamics.

To do this we used Health Mapper software, as its name suggests, it is used in the health sector; however, it is a equipped with map interface. This one was designed and developed to support the main

functions of mapping and spatial analysis. It allows users to create interactive maps and graphics, allowing you to view and analyze all data.

The data manager allows to link indicators of geographical data, in order to analyze and map. Ergo, the users can link their data (while continuing to update them) at different geographical levels such as villages, districts, regions, countries. This process allows us to make a (GIS) Geographic Information Systems that provide an excellent means of spatial analysis and data.

8. Tourism, vector of local architecture rehabilitation:

The local architecture makes up a veritable cultural and economic resource, and the basis of an adequate, sustainable and environmentally friendly development. Its rehabilitation as one of the levers of development in these rural communities, facing new patterns of urbanization and construction, will shun the occupation of agricultural lands. The tourist activity and new uses linked with may be used wisely, to avoid the inadequate environmental and socio-cultural transformations by local communities.

Some countries have moved towards the rehabilitation of local architectures such as New Mexico. In other cases; it is implemented in tourism as in Spain, Tunisia and Morocco. The rural tourist accommodations can have their own distinctive footprint, in each Zab. Their integration in sustainable development programs is the key to determine the environmental and sociocultural accommodation facility of each Zab.

8.1. Rehabilitation of ksour to points of urban decentralization*:*

The tourism development done through the rehabilitation of local architecture may open multiple perspectives. Ksour will attract people to the abandoned human establishments what makes of them points of urban decentralization. There will be a generating process of both: skilled manpower constituting a veritable employment exchange in the ksour, and local materials and traditional techniques which are predominant economic potentialities. This process will recover handicrafts, agricultural work and mainly get back *the palm grove*s. This recovery will also promote the autonomy and the economic independence of each human grouping.

8.2. The tourist tours as a link between the Ksour and Dachra:

Based on the itineraries of caravanserais and traders we will conceive the connection of the various human establishments (Fig.7.) And we only recover the ancient routes of Zab cited above. The experience of tourist tours as a means of cultural heritage safe guarding has already been used in France. [24] Zab Chergui is qualified by the cropland and an accumulation of a capital sustainably linked to trans-Saharan trade. This area of settlement is articulated around two notable centers Sidi Okba in the West: site of visit polarized by the tomb of the Islamic conqueror Okba Ibn Nafaa Elfehri and Khanguet Sidi Nadji in the East: site of the Rahmania brotherhood.

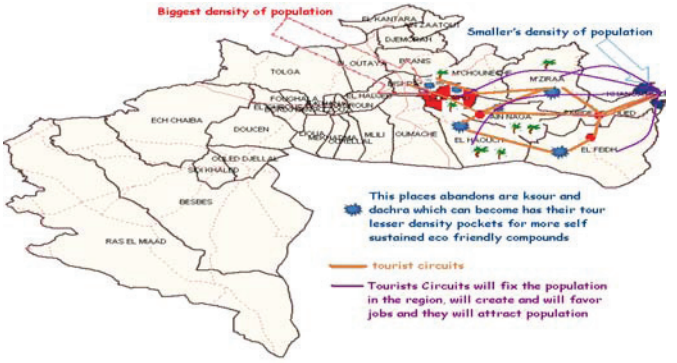


Fig.7. Proposal for a tourist development. Source: auteur (Health-Mapper).

The precedent map illustrates a tourism development and rehabilitation of *Ksour* into *self-sustainable urban units* so that they would be ecological components.

9. Conclusion

The Sustainable development is mainly based on the three pillars: economy, society and environment hence the need for this scientific approach to find the ratio between the oasis trilogy: *population*, *human establishments* and *palm trees*, especially the last one since it represents both economic and environmental capital of *Ziban*.

The return to agriculture and palm trees, which is the original culture of *Ziban* particularly and the desert generally, becomes a necessity. In order to promote the use of palm trees, it must be integrated in development and urban planning.

The ratio of 19 *palm trees* per person and the deficit accumulated over time, virtually a century, is an urgent need that must be taken into account. This instrumental deficit or ratio explains how the surface of the Ksar is almost negligible compared to the surface of its *palm grove*.

The rehabilitation of the *Ksour and Dachra* using a tourism development appropriate to the local characteristics of the region may be an instrument of:

- Urban decentralization and reappropriation of abandoned spaces.
- Preservation of biodiversity in these oases.
- These abandoned spaces can become again *self sustainable urban units*.
- The tourist tours will set the *population*, create jobs, promote crafts and particularly improve the incomes of farmers.

References:

[1] Côte, Marc ,.L'urbanisation saharienne, In séminaire « L'espace oasien et le développement durable, Université de Biskra,C.R.S.T.R.A Algérie, 2000; p.07-12

[2] Takano, T., Fu, J.,. Age-adjusted mortality and its association to variations in urban conditions in Shanghai. Health Policy, 2002, p 239–253.

[3] Orville, R. E., G. Uffines, J. Nielsen-Gammon, R. Zhang, R. Ely, S. Steiger, S. Phillips,S. Allen, and W. Read, Enhancement of Cloud-to-Ground lightning over Houston, Texas. Geophysical Research Letter 28: 2597-600. 2000;

[4] Holger Dalkmann, Team Leader Environmental Assessment, Centre for Sustainability, Transport Research Laboratory.

[5] Schéma directeur d'aménagement touristique "SDAT 2025" Livre1_ Le diagnostic : l'audit du tourisme algérien,2008, p. 43

[6] La monographie de la wilaya de Biskra, 2009 ;

[7] Colonel Niox, Geographie militaire Algérie et Tunnisise, p. 38-39, 1890 ;

[8] Alkama, Dj. : For A New Approach of urbanization in the Drylands Case Of The Sahara Down *Ziban* the Oued Souf and Righ. Doctoral thesis at the University Mohamed Kheider in Biskra. 2006;

[9] Cote, Marc L'Algérie ou l'espace retourné. Flammarion éditions, Paris. 1988 ;

[10] Soumia, B.L.: Return to palm plantation of *Ziban* as Element of sustainable urban organization. In International Seminar On Sustainable Building Design "SBD08" , Liverpool, U.K. July 2008;

[11] Bisson J.: Développement et mutations au Sahara Maghrébin. Orléans Tours, CRDP, 1995 ; p.172.

[12] Wackermann, G., Le développemnt durable. Ed. Ellipses 2008 ; p. 33.

[13] Côte M., la ville et le désert. Le bas sahara algérien.editions Karathala et Iremam, 2005 ; p.190.

[14] Brac de La Perrière B.-A., —Connaissez-vous le palmier dattier, Aix-en-Provence, Edisud. 1995 ;

[15] Wackermann, G. et Dumont, G. : Ville et environnement. Ed. Ellipses 2005 ; p. 195.

[16] L'OMT Organisation mondiale du tourisme, Développement durable du tourisme dans les déserts – Lignes directrices à l'intention des décideurs. OMT, Madrid. .2006 ; p.9

[17] Idem 16

[18] Ouennoughi m., in « Maintien des pratiques de cultures phoenicicoles oasiennes » in colloque « histoire et agronomie : entre ruptures et duree », IRD editions institut de recherche pour le developpement collection colloques et seminaires, paris, 2007 ; p.377-390

[19] Idem 14

[20] Kahn F., — Les Palmiers de l'Eldorado, Orstom Editions, Paris. 1997

[21] Colonel DELARTIGUE, 1904 ; p. 5-9

[22] Paulet J..P, « le développement durable » Ed. ellipses. 2005

[23] " Les villes durables " in Ecologie Politique, printemps, 1995 ; p. 31-79.

[24] Julien A. et al. : « La Pierre Apprivoisée : L'architecture Vernaculaire En pierre Sèche Dans Le Var (XVIIIe-XIXe Siècle) In Séminaire du Pôle Rural du 13 décembre 2005.